

PESTICIDE SURFACE WATER AND SEDIMENT QUALITY REPORT

OCTOBER 2011 SAMPLING EVENT



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Pesticide Monitoring Program Report: October 2011 Sampling Event

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Summary

As part of the South Florida Water Management District's (SFWMD) quarterly ambient monitoring program, unfiltered water and sediment samples were collected October 24 to October 27, 2011, and analyzed for over 70 pesticides and/or products of their degradation.

The herbicides 2,4-D, ametryn, atrazine, and hexazinone along with the degradate atrazine desethyl, were detected in one or more of these surface water samples. No harmful impacts are expected from the detected pesticides.

The herbicide ametryn and the insecticides/degradates DDD, DDE, DDT, along with one PCB compound were found in the sediment at several locations. Three DDE and one DDD compound sediment concentrations were of a magnitude considered to have a harmful effect to freshwater sediment-dwelling organisms. No harmful impacts are expected from the other detected pesticides.

The compounds and concentrations found are typical of those expected from an area of intensive historical and contemporary agricultural activity.

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Background and Methods

The SFWMD pesticide monitoring network includes stations designated in the Everglades Settlement Agreement, the Lake Okeechobee Protection Act Permit, and the non-Everglades Construction Project (non-ECP) permit. The canals and marshes depicted in **Figure 1** are protected as Florida Administrative Code (F.A.C.) 62-302 Class III (fishable and swimmable) waters, while Lake Okeechobee and a segment of the Caloosahatchee River are protected as a Class I drinking water supply. Water Conservation Area 1 (WCA-1) and the Everglades National Park are also designated as Outstanding Florida Waters, to which anti-degradation standards apply. Surface water and sediment are sampled quarterly and semiannually, respectively, upstream at each structure identified in the permit or agreement. Sediment samples are collected using a petite Ponar® dredge.

Seventy-three pesticides and degradation products were analyzed in samples from 26 of the network 27 sites (**Figure 1**). The analytes, their respective method detection limits (MDLs), and practical quantitation limits (PQLs) are listed in **Table 1**. All the analytical work is performed by the Florida Department of Environmental Protection (FDEP) Central Laboratory in Tallahassee, Florida. Analytical method details can be found at the following location: <http://www.dep.state.fl.us/labs/cgi-bin/sop/chemsop.asp>.

To evaluate the potential impacts on aquatic life, the observed concentration is compared to the appropriate criterion outlined in F.A.C. 62-302.530. If a pesticide compound is not specifically listed, acute and chronic toxicity criterion are calculated as one-third and one-twentieth, respectively, of the amount lethal to 50% of the test organisms in 96 hours, using the lowest technical grade effective concentration 50 (EC₅₀) or lethal concentration 50 (LC₅₀) reported in the summarized literature for the species significant to the indigenous aquatic community (F.A.C. 62-302.200). Each pesticide's description and possible uses and sites of application described herein are taken from Hartley and Kidd (1987). Sediment concentrations are compared to freshwater sediment quality assessment guidelines (MacDonald Environmental Sciences, Ltd., and United States Geological Survey, 2003). A value below the threshold effect concentration (TEC) should not have a harmful effect on sediment-dwelling organisms. Values above the probable effect concentration (PEC) demonstrate that harmful effects to sediment-dwelling organisms are likely to be frequently or always observed. This summary covers surface water and sediment samples collected from October 24 to October 27, 2011.

Results

At least one pesticide was detected in surface water at 11 of the 26 sites and in sediment at 7 of the 23 sites. The non-ECP permit requires sampling at S142 only during discharge or flow events. For this sampling event, no sample was obtained due to the lack of discharge at the time of sample collection. A sediment sample could not be safely collected at S65E due to the strong currents generated by the structure gate openings. Sediment samples are not collected at S333, S356-334, and TAMBR105, due to no requirement in the respective mandate. All of these compounds have previously been detected in this monitoring program.

The sediment DDE concentrations at S2, S5A, and S6 as well as the DDD concentration at S6,

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were of a magnitude considered to represent detrimental effects to sediment-dwelling organisms in freshwater sediments. All other detected concentrations in the surface water and sediment were below any effect level.

The above findings must be considered with the caveat that pesticide concentrations in surface water and sediment may vary significantly in relation to the timing and magnitude of pesticide application, rainfall events, pumping and other factors, and that this was only one sampling event. The possible acute and chronic toxicity and environmental fate impacts are reported based on the single sampling event and do not take into account previous monitoring data.

Usage and Water Quality Impacts

2,4-D: 2,4-D is a selective systemic herbicide used for the post-emergence control of annual and perennial broad leaf weeds in terrestrial (grassland, established turf, sugarcane, rice, and on non-crop areas) as well as aquatic areas. Environmental fate and toxicity data in **Tables 4 and 5** indicate that 2,4-D (1) has minimum loss from soil by surface adsorption, with a moderate loss by leaching and surface solution; (2) is slightly toxic to mammals and relatively non-toxic to fish; and (3) does not bioaccumulate significantly. The only 2,4-D residue was detected at S5A (0.31 micrograms per liter [$\mu\text{g/L}$]) (**Table 2**). Using these criteria, this observed level should not have an acute or chronic effect on fish or aquatic invertebrates.

Ametryn: Ametryn is a selective terrestrial herbicide registered for use on sugarcane, bananas, pineapple, citrus, corn, and non-crop areas. Most algal effects occur at concentrations greater than ($>$) 10 $\mu\text{g/L}$ (Verschuere, 1983). Environmental fate and toxicity data in **Tables 4 and 5** indicate that ametryn (1) is lost from soil relatively easily by leaching, surface adsorption, and in surface solution; (2) is relatively non-toxic to mammals and fish; and (3) does not bioconcentrate significantly. Additional fish toxicity data include a 96-hour LC_{50} of 14.1 milligrams per liter (mg/L) for goldfish (Hartley and Kidd, 1987). The ametryn surface water concentrations found in this sampling event ranged from 0.019 to 0.057 $\mu\text{g/L}$ (**Table 2**). Using these criteria, these observed surface water concentrations should not have an acute, detrimental impact on fish or aquatic invertebrates. Ametryn was detected in the sediment at S5A at 22 micrograms per kilogram ($\mu\text{g/Kg}$) (**Table 3**). However, no sediment guidelines have been developed for ametryn.

Atrazine: Atrazine is a selective systemic herbicide registered for use on pineapple, sugarcane, corn, rangelands, ornamental turf and lawn grasses, and non-crop areas. Environmental fate and toxicity data in **Tables 4 and 5** indicate that atrazine (1) is easily lost from soil by leaching and in surface solution, with moderate loss from surface adsorption; (2) is relatively non-toxic to mammals and fish; and (3) does not bioconcentrate significantly. Additional fish toxicity data include a 96-hour LC_{50} of 76 mg/L for carp, 16 mg/L for perch, and 4.3 mg/L for guppies (Hartley and Kidd, 1987). Also, in a flow-through bioassay, the maximum acceptable toxicant concentration (MATC) of atrazine was 90 and 210 $\mu\text{g/L}$ for bluegill and fathead minnow, respectively (Verschuere, 1983). The draft ambient aquatic life water quality criterion identifies a one-hour average concentration that does not exceed 1,500 $\mu\text{g/L}$ more than once every three years on the average (United States Environmental Protection Agency [U.S. EPA], 2003). The atrazine

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surface water concentrations found in this sampling event at 9 of the 26 sampling locations, ranged from 0.029 to 0.42 µg/L (**Table 2**). Using these criteria, these observed surface water concentrations should not have an acute or chronic detrimental impact on fish or invertebrates. Atrazine was not detected in the sediment.

Atrazine desethyl (DEA) and atrazine desisopropyl (DIA) are biotic degradation products of atrazine. These degradation products are both persistent and mobile in water; however, DEA is more stable and the dominant initial metabolite. Since DEA and DIA are structurally and toxicologically similar to atrazine, the concentrations of total atrazine residue (atrazine + DEA + DIA) may also be a significant consideration in the surface water environment. The DEA to atrazine ratio (DAR), on a molar basis, has been suggested as an indicator of nonpoint-source pollution of groundwater (Adams and Thurman, 1991) and as a tracer of groundwater discharge into rivers (Thurman et al., 1992). Goolsby et al. (1997) determined that low DAR values, median <0.1, occur in streams during runoff shortly after application of atrazine. Higher DAR values, median about 0.4, occur later in the year after considerable degradation of atrazine to DEA has occurred in the soil (Goolsby et al. (1997). The low median DAR ratio (e.g. 0.06) at the locations where both atrazine and DEA were detected, suggests minimum degradation of atrazine (**Table 6**). However, these general guidelines were developed based on observations in Midwest watersheds in northern temperate climates with different soil and water management regimes as well as higher atrazine water concentrations. Applications to the South Florida environment should be made with caution.

DDD, DDE, DDT: DDE is an abbreviation of **dichlorodiphenyldichloroethylene** [2, 2-bis (4-chlorophenyl)-1, 1-dichloroethene]. DDE is an environmental dehydrochlorination product of DDT (**dichlorodiphenyltrichloroethane**), a popular insecticide for which the U.S. EPA cancelled all uses in 1973. The large volume of DDT used, the persistence of DDT, DDE and another metabolite, DDD (**dichlorodiphenyldichloroethane**), and the high K_{oc} of these compounds account for the frequent detections in sediments. The large hydrophobicity of these compounds also results in a significant bioconcentration factor (**Table 4**). In sufficient quantities, these residues have reproductive effects in wildlife and carcinogenic effects in many mammals.

The DDD sediment concentrations detected range from 11 to 97 µg/Kg (**Table 3**). Any concentration which would fall below the TEC (4.9 µg/Kg) should not impact sediment dwelling organisms while concentrations above the PEC (28 µg/Kg), frequently or always have the possibility for impacting sediment-dwelling organisms. Two of the three sediment concentrations detected were between the TEC and PEC. These concentrations may have the possibility for harmful effects on freshwater sediment-dwelling organisms. The sediment concentration detected at S6 (97 µg/Kg) exceeded the PEC. DDD was not detected in the surface water.

The TEC is 3.2 µg/Kg and the PEC is 31 µg/Kg for DDE in freshwater sediments. The concentration of DDE detected at S2, S5A, and S6 (**Table 3**) exceeded the PEC and frequently or always have the possibility for impacting sediment-dwelling organisms. DDE was not detected in the surface water.

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The DDT concentration detected at S6 (**Table 3**) exceeded the TEC (4.2 µg/Kg) but not the PEC (63 µg/Kg). At these levels, there may be a possibility for impacting sediment-dwelling freshwater organisms. No DDT was detected in the surface water.

Hexazinone: Hexazinone is a non-selective contact herbicide that inhibits photosynthesis. Registered uses include sugarcane, pineapple, and non-crop areas. Environmental fate and toxicity data in **Tables 4 and 5** indicate that hexazinone (1) is easily lost from soil by leaching, with moderate loss from surface adsorption or surface solution; (2) is relatively non-toxic to mammals and fish; and (3) does not bioconcentrate significantly. Hexazinone is practically non-toxic to freshwater invertebrates with an EC₅₀ of 145 mg/L for *Daphnia magna* (U.S. EPA, 1988). The only surface water concentration detected in this sampling event at S191 (0.40 µg/L) (**Table 2**) should not have an acute impact on fish or aquatic invertebrates. Hexazinone was not detected in the sediment.

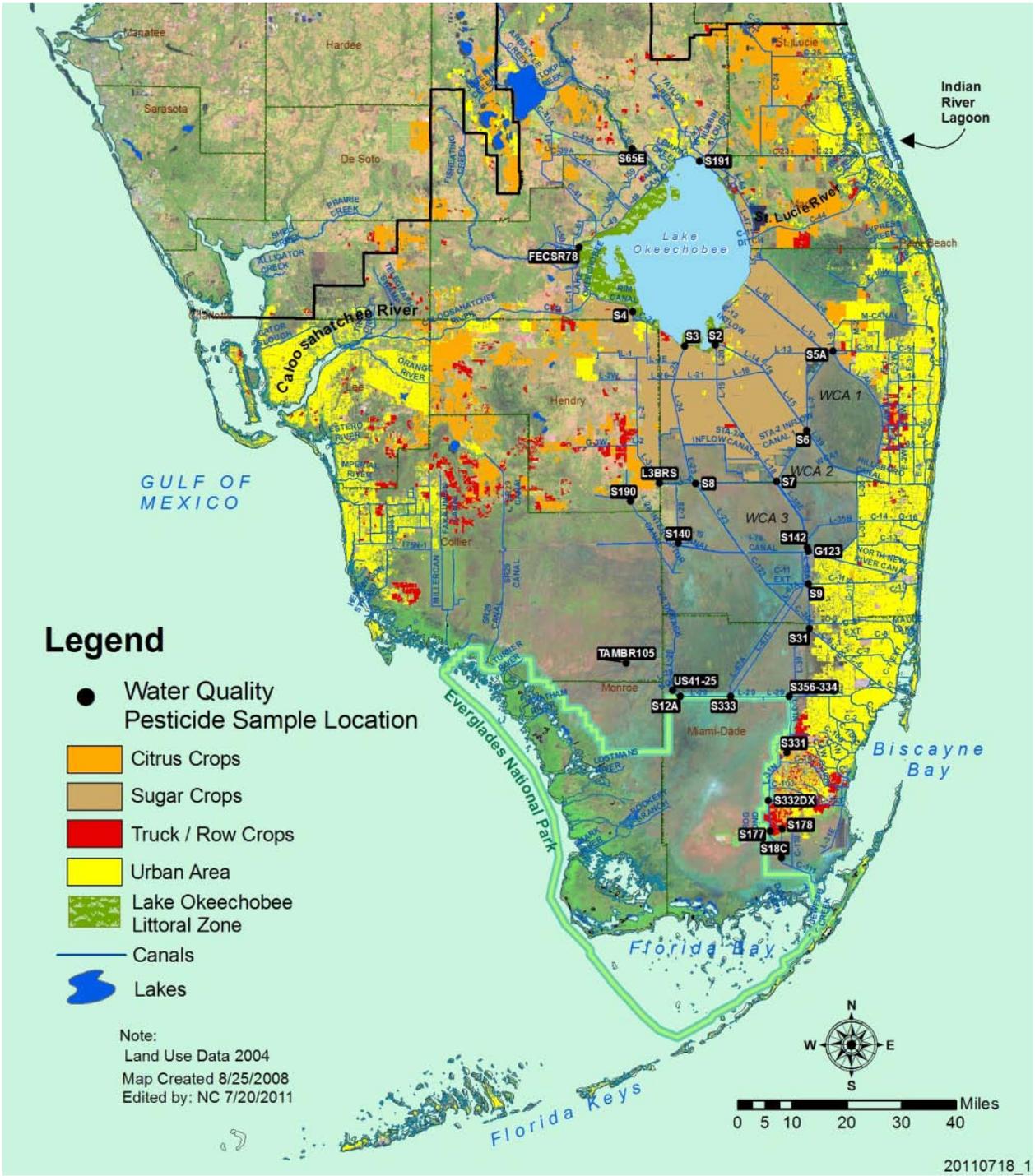
PCBs: Polychlorinated biphenyls (PCBs) is the generic term for a group of 209 congeners that contain a varying number of substituted chlorine atoms on one or both of the biphenyl rings. PCB-1260 is a commercial grade mixture containing 60 percent chlorine by weight. Production of PCBs was banned in 1978 and closed system uses are being phased out. In natural water systems, PCBs are found primarily sorbed to suspended sediments due to the very low solubility in water (Callahan et al., 1979). The tendency of PCBs for adsorption increases with the degree of chlorination and with the organic content of the adsorbent. While the production ban, phase out of uses, and stringent spill clean-up requirements have significantly reduced environmental loadings in recent years, the persistence and tendency to accumulate in sediment and bioaccumulate in fish, make this class of organochlorine compounds especially problematic. The TEC and PEC are 60 µg/Kg and 680 µg/Kg, respectively, for total PCBs. The sediment residue detected at S6 (**Table 3**) is greater than the TEC but less than the PEC. This concentration has a possibility for impacting freshwater sediment-dwelling organisms. None of the PCB congeners were detected in the surface water.

Quality Assurance Evaluation

No pesticide analytes were detected in the equipment blanks performed at S18C, S191, S331, S8, US41-25, and S5A. All of the collected samples were shipped and all bottles were received.

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Figure 1. South Florida Water Management District Pesticide Monitoring Network.



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Table 1. Method detection limits (MDLs) and practical quantitation limits (PQLs) for October 2011 sampling event.

Pesticide or metabolite	Water: range of MDLs - PQLs (µg/L)	Sediment: range of MDLs - PQLs (µg/Kg)	Pesticide or metabolite	Water: range of MDLs - PQLs (µg/L)	Sediment: range of MDLs - PQLs (µg/Kg)
2,4-D	0.2 - 0.62	8.9 - 190	endrin aldehyde	0.0042 - 0.016	0.91 - 27
2,4,5-T	0.2 - 0.62	8.9 - 190	ethion	0.0094 - 0.04	2.3 - 67
2,4,5-TP (silvex)	0.2 - 0.62	8.9 - 190	ethoprop	0.0094 - 0.04	2.3 - 67
acifluorfen	0.2 - 0.62	8.9 - 190	fenamiphos	0.038 - 0.16	4.5 - 130
alachlor	0.057 - 0.24	14 - 400	fonofos	0.0094 - 0.04	2.3 - 67
aldrin	0.0019 - 0.008	0.45 - 13	heptachlor	0.0023 - 0.0096	0.45 - 13
ametryn	0.0094 - 0.01	2.3 - 67	heptachlor epoxide	0.0019 - 0.008	0.45 - 13
atrazine	0.0094 - 0.04	2.3 - 67	hexazinone	0.019 - 0.08	4.5 - 130
atrazine desethyl	0.0094 - 0.04	N/A	imidacloprid	0.22 - 0.68	N/A
atrazine desisopropyl	0.0094 - 0.04	N/A	linuron	0.22 - 0.68	8.1 - 180
azinphos methyl (guthion)	0.028 - 0.12	6.8 - 200	malathion	0.028 - 0.12	4.5 - 130
α-BHC (alpha)	0.0021 - 0.0088	0.45 - 13	metalaxyl	0.047 - 0.2	N/A
β-BHC (beta)	0.0032 - 0.14	0.45 - 13	methamidophos	N/A	23 - 670
δ-BHC (delta)	0.0019 - 0.002	0.45 - 13	methoxychlor	0.0094 - 0.04	3.2 - 93
γ-BHC (gamma) (lindane)	0.0019 - 0.8	0.45 - 13	metolachlor	0.057 - 0.24	14 - 400
bromacil	0.047 - 0.2	9.1 - 270	metribuzin	0.019 - 0.08	4.5 - 130
butylate	0.019 - 0.078	N/A	mevinphos	0.057 - 0.24	9.1 - 270
carbophenothion (trithion)	0.015 - 0.064	1.4 - 40	mirex	0.011 - 0.048	0.91 - 27
chlordan	0.019 - 0.08	4.5 - 130	monocrotophos	N/A	23 - 670
chlorothalonil	0.015 - 0.064	1.4 - 40	naled	0.075 - 0.08	18 - 530
chlorpyrifos ethyl	0.0094 - 0.04	2.3 - 67	norflurazon	0.019 - 0.08	4.5 - 130
chlorpyrifos methyl	0.019 - 0.08	4.5 - 130	parathion ethyl	0.019 - 0.08	4.5 - 130
cypermethrin	0.019 - 0.08	2.3 - 67	parathion methyl	0.019 - 0.08	4.5 - 130
DDD-p,p'	0.0045 - 0.019	0.91 - 27	PCB-1016	0.019 - 0.08	4.5 - 130
DDE-p,p'	0.0038 - 0.016	0.91 - 140	PCB-1221	0.019 - 0.08	9.1 - 270
DDT-p,p'	0.0057 - 0.024	1.4 - 40	PCB-1232	0.019 - 0.08	4.5 - 130
demeton	0.028 - 0.12	6.8 - 200	PCB-1242	0.019 - 0.08	4.5 - 130
diazinon	0.019 - 0.08	2.3 - 67	PCB-1248	0.019 - 0.08	4.5 - 130
dicofol (kelthane)	0.042 - 0.18	5.5 - 160	PCB-1254	0.019 - 0.08	6.8 - 200
dieldrin	0.0019 - 0.008	0.45 - 13	PCB-1260	0.019 - 0.08	4.5 - 130
disulfoton	0.019 - 0.08	2.3 - 67	permethrin	0.015 - 0.064	2.3 - 67
diuron	0.22 - 0.68	8.1 - 180	phorate	0.0094 - 0.04	2.3 - 67
α-endosulfan (alpha)	0.0038 - 0.016	0.45 - 13	prometon	0.019 - 0.08	N/A
β-endosulfan (beta)	0.0038 - 0.016	0.45 - 13	prometryn	0.019 - 0.08	4.5 - 130
endosulfan sulfate	0.0045 - 0.019	0.91 - 27	simazine	0.0094 - 0.04	2.3 - 67
endrin	0.0094 - 0.04	1.5 - 43	toxaphene	0.094 - 0.4	27 - 800
			trifluralin	0.0075 - 0.032	1.8 - 53

N/A – not analyzed

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Table 2. Summary of pesticide residues ($\mu\text{g/L}$) detected above the method detection limit in surface water samples collected by SFWMD in October 2011.

Date	Location	Flow	2,4-D	ametryn	atrazine	atrazine desethyl	hexazinone	Number of compounds detected at location
10/24/2011	S177	Y	-	-	-	-	-	0
	S178	N	-	-	-	-	-	0
	S18C	Y	-	-	-	-	-	0
	S331	Y	-	-	-	-	-	0
	S332DX	Y	-	-	-	-	-	0
10/25/2011	S191	Y	-	-	-	-	0.40	1
	S65E	Y	-	-	0.043	-	-	1
	FECSR78	Y	-	-	-	-	-	0
	S12A	Y	-	-	-	-	-	0
	S2	N	-	0.051	0.27	-	-	2
	S3	N	-	0.043	0.42	0.016 I	-	3
	S31	N	-	-	-	-	-	0
	S333	N	-	-	0.029 I	-	-	1
	S356-334	N	-	-	-	-	-	0
	S4	N	-	0.057	0.35	-	-	2
	S9	Y	-	-	0.17	0.012 I	-	2
	TAMBR105	N	-	-	-	-	-	0
	US41-25	N	-	-	-	-	-	0
10/26/2011	G123	N	-	-	-	-	-	0
	L3BRS	N	-	-	-	-	-	0
	S140	Y	-	-	-	-	-	0
	S8	Y	-	0.019 I	0.043	-	-	2
	S190	Y	-	-	-	-	-	0
10/27/2011	S7	Y	-	0.028 I	-	-	-	1
	S6	N	-	0.042	0.17	-	-	2
	S5A	N	0.31 I	0.047	0.065	-	-	3
Total number of compound detections			1	7	9	2	1	20

N – no, Y – yes, R – reverse; - denotes that the result is below the method detection limit.

I – value reported is less than the practical quantitation limit, and greater than or equal to the method detection limit

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Table 3. Summary of pesticides residues ($\mu\text{g}/\text{Kg}$) detected above the method detection limit in sediment samples collected by SFWMD in October 2011.

Date	Location	Flow	ametryn	DDD-p,p'	DDE-p,p'	DDT-p,p'	PCB-1260	Number of compounds detected at location
10/24/2011	S178	N	-	-	11 I	-	-	1
	S177	Y	-	-	6.5	-	-	1
10/25/2011	S2	N	-	11 I	49	-	-	2
	S3	N	-	-	18 I	-	-	1
	S4	N	-	-	8.1	-	-	1
10/27/2011	S5A	N	22 I	17 I	99	-	-	3
	S6	N	-	97	340	12 I	61 I	4
Total number of compound detections			1	3	7	1	1	13

N – no, Y – yes, R – reverse; - denotes that the result is below the method detection limit

I – value reported is less than the practical quantitation limit, and greater than or equal to the method detection limit

Values in bold, italicized font are at a concentration that harmful effects to sediment-dwelling organisms are likely to be frequently or always observed.

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Table 4. Selected properties of pesticides detected during the October 2011 sampling event.

Common Name	Surface Water Standards F.A.C. 62-302 (µg/L)	Acute Oral LD ₅₀ For Rats (mg/kg) (1)	Bioconcentration Factor (2)	Volatility from Water (2)	Soil Conservation Service (SCS) rating (3)			K _{OC} (mL/g) (3, 4)	Soil Half-life (days) (3, 4)	Water Solubility (WS) (mg/L) (3, 4)	U.S. EPA Carcinogenic Potential (5)
					LE	SA	SS				
2,4-D (acid)	(100)	375	13	I	M	SA	M	20	10	890	D
ametryn	-	1,110	33	I	M	M	M	300	60	185	D
atrazine	-	3,080	86	I	L	M	L	100	60	33	C
DDD-p,p'	-	3,400	3,173	I	-	-	-	239,900	-	0.055	-
DDE-p,p'	-	880	2,887	S	-	-	-	243,220	-	0.065	-
DDT-p,p'	0.001	113	15,377	I	-	-	-	140,000	-	0.00335	-
hexazinone	-	1,690	2	I	L	M	M	54	90	33,000	D
PCB's	0.014	-	-	-	-	-	-	-	-	-	B2

- No data available

FDEP F.A.C. 62-302 surface water standards (4/2008) for Class III waters except Class I noted in ()

Bioconcentration Factor (BCF) calculated as $BCF = 10^{(2.71 - 0.564 \log WS)}$ (2)

Volatility from water: R = rapid, I = insignificant, S = significant

SCS ratings are pesticide loss due to leaching (LE), surface adsorption (SA) or surface solution (SS) and grouped as large (L), medium (M), small (S), or extra small (XS)

B2: probable human carcinogen; C: possible human carcinogen; D: not classified; E: evidence of non-carcinogen for humans (5)

(1) Hartley and Kidd (1987)

(2) Lyman, et al. (1990)

(3) Goss and Wauchope (1992)

(4) Montgomery (1993)

(5) U.S. EPA (1996)

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Table 5. Toxicity of pesticides detected during the October 2011 sampling event to freshwater aquatic invertebrates and fishes (µg/L).

Common Name	48 hr EC ₅₀		96 hr LC ₅₀ Fathead Minnow (#)		96 hr LC ₅₀ Bluegill <i>Lepomis macrochirus</i>		96 hr LC ₅₀ Largemouth Bass <i>Micropterus salmoides</i>		96 hr LC ₅₀ Rainbow Trout (#)		96 hr LC ₅₀ Channel Catfish <i>Ictalurus punctatus</i>							
	Water flea <i>Daphnia magna</i>	Acute Toxicity (*)	Chronic Toxicity (*)	Minnow (#)	Acute Toxicity (*)	Chronic Toxicity (*)	Bluegill <i>Lepomis macrochirus</i>	Acute Toxicity (*)	Chronic Toxicity (*)	Largemouth Bass <i>Micropterus salmoides</i>	Acute Toxicity (*)	Chronic Toxicity (*)	Rainbow Trout (#)	Acute Toxicity (*)	Chronic Toxicity (*)	Channel Catfish <i>Ictalurus punctatus</i>	Acute Toxicity (*)	Chronic Toxicity (*)
2,4-D	25,000 (5)	8,333	1,250	133,000 (5)	44,333	6,650	180,000 (9)	60,000	9,000	-	-	-	100,000 (2)	33,333	5,000	-	-	-
	-	-	-	-	-	-	900 (48 hour) (4)	300	45	-	-	-	110,000 (5)	36,667	5,500	-	-	-
ametryn	28,000 (5)	9,333	1,400	16,000 (6)	5,333	800	4,100 (2)	1,367	205	-	-	-	8,800 (2)	2,933	440	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	3,600 (6)	1,200	180	-	-	-
atrazine	6,900 (5)	2,300	345	15,000 (5)	5,000	750	16,000 (2)	5,333	800	-	-	-	8,800 (2)	2,933	440	7,600 (2)	2,533	380
	-	-	-	-	-	-	-	-	-	-	-	-	5,300 (7)	1,767	265	-	-	-
DDD-p,p'	3,200 (4)	1,067	160	4,400 (1)	1,467	220	42 (1)	14	2.1	42 (1)	14	2.1	70 (1)	23.3	4	1,500 (1)	500	75
DDE-p,p'	-	-	-	-	-	-	240 (1)	80	12	-	-	-	32 (1)	10.7	2	-	-	-
DDT-p,p'	-	-	-	19 (3)	6.3	0.95	8 (3)	2.7	0.40	2 (3)	0.7	0.1	7 (3)	2.3	0.4	16 (3)	5.3	0.8
hexazinone	151,600 (5)	50,533	7,580	274,000 (2)	91,333	13,700	100,000 (5)	33,333	5,000	-	-	-	180,000 (5)	60,000	9,000	-	-	-
	151,600 (8)	50,533	7,580	274,000 (8)	91,333	13,700	505,000 (8)	168,333	25,250	-	-	-	>320,000 (8)	>106,667	>16,000	-	-	-

- No data available

(*) Florida Administrative Code (F.A.C.) 62-302.200, for compounds not specifically listed, acute and chronic toxicity standards are calculated as one-third and one-twentieth, respectively, of the amount lethal to 50% of the test organisms in 96 hours, where the 96 hour LC₅₀ is the lowest value which has been determined for a species significant to the indigenous aquatic community.

(#) Species is not indigenous. Information is given for comparison purposes only.

- (1) Johnson and Finley (1980)
- (2) Hartley and Kidd (1987)
- (3) Montgomery (1993)
- (4) Verschueren (1983)
- (5) U.S. EPA (1991)
- (6) U.S. EPA (2005)
- (7) U.S. EPA (2006)
- (8) U.S. EPA (1994)
- (9) Mayer and Ellersieck (1986)

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Table 6. Atrazine Desethyl (DEA)/Atrazine ratio (DAR) data for October 2011 sampling event.

Date	Location	Flow ⁺	atrazine		atrazine desethyl		DAR
			µg/L	moles/l	µg/L	moles/l	
10/25/2011	S3	N	0.42	1.95E-09	0.016	8.53E-11	0.04
	S9	Y	0.17	7.88E-10	0.012	6.40E-11	0.08
			DAR	All sites	Flow only sites	No flow sites	
			average	0.06	0.08	0.04	
			median	0.06	0.08	0.04	
			minimum	0.04	0.08	0.04	
			maximum	0.08	0.08	0.04	

* N – no, Y – yes, R - reverse

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Glossary

Bioconcentration Factor: The ratio of the concentration of a contaminant in an aquatic organism to the concentration in water, after a specified period of exposure via water only. The duration of exposure should be sufficient to achieve a near steady-state condition.

EC₅₀: A concentration necessary for 50 percent of the aquatic species tested to exhibit a toxic effect short of mortality (e.g., swimming on side or upside down, cessation of swimming) within a short (acute) exposure period, usually 24 to 96 hours.

Henry's law constant (H): Relates the concentration of a compound in the gas phase to its concentration in the liquid phase. The constant is calculated from the formula: $H = P_{vp}/S$ where P_{vp} is pressure in atmospheres and S is solubility in moles/meter³ for a compound.

K_{oc}: The soil/sediment partition or sorption coefficient normalized to the fraction of organic carbon in the soil. This value provides an indication of the chemical's tendency to partition between soil organic carbon and water.

LC₅₀: A concentration which is lethal to 50 percent of the aquatic animals tested within a short (acute) exposure period, usually 24 to 96 hours.

LD₅₀: The dosage which is lethal to 50 percent of the terrestrial animals tested within a short (acute) exposure period, usually 24 to 96 hours.

Method Detection Limits (MDLs): The minimum concentration of an analyte that can be detected with 99 percent confidence of its presence in the sample matrix.

Practical Quantitation Limits (PQLs): The lowest level of quantitation that can be reliably achieved within specified limit of precision and accuracy during routine laboratory operating conditions. The PQLs are further verified by analyzing spike concentrations whose relative standard deviation in 20 fortified water samples is < 15 percent. In general, PQLs are 2 to 5 times larger than the MDLs.

Probable Effect Concentration (PEC): The probable effect concentration is intended to identify concentrations above which harmful effects to sediment-dwelling organisms are likely to be frequently or always observed.

Soil or water half-life: The time required for one-half the concentration of the compound to be lost from the water or soil under the conditions of the test.

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Threshold Effect Concentration (TEC): The threshold effect concentration is intended to identify concentrations below which harmful effects to freshwater sediment-dwelling organisms are unlikely to be observed.

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